TAB A

TO EXHIBIT 14

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

CRYOVAC, INC., Plaintiff and Counter-Defendant, v. PECHINEY PLASTIC PACKAGING, INC., Defendant and Counter-Plaintiff.	Civil Action No. 04-1278 Hon. Kent A. Jordan

Declaration of Seymour G. Gilbert

I, Seymour G. Gilbert, declare as follows:

1. I received my B.S. degree in 1935, M.S. degree in 1938, and Ph.D. in 1941 from Rutgers University.

2. I worked at Pabst Company as a Research Chemist from 1951-1958.

3. I began as a principal scientist at Milprint, Inc. in 1958 and left in 1965 as the Corporate Technical Director.

4. I served as Professor of the Food Science Department at Rutgers University from 1965-1988.

5. I served as Deputy Director of the Packaging Science and Engineering Program in the Engineering School at Rutgers University from 1988-1998.

6. I have patents on packaging films, as well as, other areas. My 200 publications include work on polymers and their uses, including multilayer films. I consulted, designed and produced the food packaging multilayer films used on the Apollo project.

7. I have conducted several studies for Allied Chemicals since coming to Rutgers in 1965. I developed special tests for evaluating packaging materials, starting at Milprint, and made such studies and major research studies after coming to Rutgers with regular publication of research findings. By agreement with Allied, the results of the studies which began in 1981 were to be published. The film samples and financial aid were provided by Allied. There were two studies for Allied.

8. The first study for Allied was completed by 1982 and its results were described in at least: 1) the article "Study of Barrier Properties of Polymeric Films to Various Organic Aromatic Vapors" by S.G. Gilbert, E. Hatzidimitriu, C. Lai and N. Passy in the 1983 Edition of Instrumental Analysis of Foods Recent Progress Volume 1; and 2) the article "Environmental and Material Composition Effects on Film Permeability as Related to Meat Packaging" by Seymour G. Gilbert, Grace R. Huang-Lai and Christopher C. Lai presented at the 36th Annual Reciprocal Meat Conference held on June 12-15, 1983.

9. The second study for Allied commenced around 1983 and included a film having the structure HDPE/TIE/NYLON/EVOH/NYLON/TIE/HDPE. I received all the films of the second study for Allied at the same time. The second study for Allied was described in at least: 1) the article "Nylon Film Effective Packaging" in the December 14, 1984 Journal of Commerce ("Journal of Commerce Article"); 2) the Allied Engineered Plastics News Release "Rutgers Study Confirms Nylon Barrier Properties for Food and Other Sensitive Packaging" ("Allied News Release"); and 3) the article "Odor Barrier Properties of Multi-Layer Packaging Films at Different Relative Humidities" by E. Hatzidimitriu, S.G. Gilbert and G. Loukakis in the March-April 1997 issue of Journal of Food Science ("Journal of Food Science Article").

10. I agree with the Allied News Release that the films of the second study for Allied were coextruded.

11. The Journal of Commerce Article disclosed nylon and EVOH used together in film structures. The first study did not include a film with nylon and EVOH used together in film structures. Only the second study included a film with nylon and EVOH used together in film structures. Therefore, the study described in the Journal of Commerce Article as "Rutgers is currently conducting additional testing for Allied" is the second study for Allied.

12. The objectives of these two studies for Allied were to determine the physical and chemical properties of film for food packaging, principally, water, gas and odor contaminant permeabilities, and physical endurance during fabrication and its long use.

13. Two main protocols were used for these two studies for Allied. The first

was for physical properties which uses a preliminary conditioning under various environmental stress conditions of temperature and humidity followed by a severe physical stressing. We used an apparatus developed by Gelbo which used the cylindrical test films suspended between two mandrels and a motor which applied both rotation and twisting to severely stress both machine and transverse directions as related to the manufacturing process. The test is particularly useful in multilayer films held together by tie layers as it applies stress to the structure as might be applied during package formation and shipping.

14. One of the factors for such properties is crystallinity and the degree of orientation of the various polymers used. All of the films supplied were tested independently prior to use at Rutgers for identifying physical and chemical properties prior to experimental use. This is done to ensure identity and to help interpret the results of sample films.

15. The methods include physical tests such as: 1) Instron Tester, which provides stress data relating to orientation; 2) Cross Polarization to visualize orientation; 3) infrared tests to identify the various components of multilayer film including its chemical composition and thickness; and 4) special gas and organic vapor permeability for barrier properties by test methods developed at my laboratory known as the Gilbert-Pegaz tester.

16. It is my recollection that results of the Instron Tester and the Cross Polarization tester showed that the 1.4 mil HDPE/TIE/NYLON/EVOH/NYLON/TIE/HDPE film, identified as Film C in the Journal of Food Science Article, was oriented.

17. It is my recollection that the infrared spectra obtained from the individual layers of the 1.4 mil HDPE/TIE/NYLON/EVOH/NYLON/TIE/HDPE film, identified as Film C in the Journal of Food Science Article, did not show any obvious differences in either composition or thickness of the corresponding layers around the center. Such differences would have been noted in our publications.

18. The permeation rates for Film C, as disclosed in Tables 2 and 3 of the Journal of Food Science Article, are consistent with the permeation rates of an oriented multilayer film exhibiting high barrier properties.

19. I was retained by Pechiney Plastic Packaging, Inc. as a consulting expert. I have consulted on matters other than the studies for Allied Chemicals.

I declare under penalty of perjury that the foregoing is true and correct.

Date: August ___, 2005

Seymour G. Gilbert

test for physical properties which was a preliminary conditioning under various environmental stress conditions of temperature and humidity followed by a severe physical stressing. We used an apparatus developed by Gelbo which used the cylindrical test films suspended between two mandrels and a motor which applied both rotation and twisting to severely stress both machine and transverse directions as related to the manufacturing process. The test is particularly useful in multilayer films held together by tie layers as it applies stress to the structure as might be applied during package formation and shipping.

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16. It is my recollection that results of the Instron Tester and the Cross Polarization tester showed that the 1.4 mil HDPE/TIE/NYLON/EVOH/NYLON/TIE/HDPE film, identified as Film C in the Journal of Food Science Article, was oriented.

17. It is my recollection that the infrared spectra obtained from the individual layers of the 2.4 mil HDPE/TIE/NYLON/EVOH/NYLON/TIE/HDPE film, identified as Film C in the Journal of Food Science Article, did not show any obvious differences in either composition or thickness of the corresponding layers around the center. Such differences would have been noted in our publications.

18. The permeation rates for Film C, as disclosed in Tables 2 and 3 of the Journal of Food Science Article, are consistent with the permeation rates of an oriented multilayer film exhibiting high barrier properties.

19. I was retained by Pechiney Plastic Packaging, Inc. as a consulting expert. I have consulted on matters other than the studies for Allied Chemicals.

I declare under penalty of perjury that the foregoing is true and correct.

Date: August 16, 2005

Seymour G. Gilbert

TAB B

TO EXHIBIT 14

IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF DELAWARE

CRYOVAC, INC.,

Plaintiff/Counter-Defendant,

CERTIFIED COPY

-vs- Civil Action

No. 04-1728-KAJ

PECHINEY PLASTIC PACKAGING, INC.,

Defendant/Counter-Plaintiff.

NOTE: PORTIONS OF TEXT DEEMED CONFIDENTIAL - SUBJECT TO PROTECTIVE ORDER

The videotaped deposition of ELDRIDGE MOUNT, III, called by the Plaintiff/Counter-Defendant for examination, pursuant to notice and pursuant to the Federal Rules of Civil Procedure for the United States District Courts pertaining to the taking of depositions, taken before Cynthia J. Conforti, Certified Shorthand Reporter, at One IBM Plaza, Chicago, Illinois, commencing at the hour of 9:02 a.m. on the 4th day of August, A.D., 2005.

MR. FUCHS: Okay. Why don't we change the tape.

THE VIDEOGRAPHER: End of tape number three. Off the record at 1:46 p.m. 01:46PM

(Whereupon a recess was had.)

THE VIDEOGRAPHER: Beginning of tape number four. On the record at 1:53 p.m.

BY MR. FUCHS:

Q. Did the Hatley article or the Journal of 01:54PM Commerce article provide any specific disclosure as to how to orient a seven-layer coextruded film?

A. I don't believe that they have a recipe for orientation or orientation conditions.

Q. Okay. Will you turn to Table 1 of the 01:54PM Exhibit 10.

A. Okay.

Q. Do you have that in front of you? And you see at the bottom there's a film key and then a description of films A, B, C, D, E, F, G, H and I. You see that?

A. Um-hmm. Excuse me.

Q. And film F is indicated as being oriented,

TAB C

TO EXHIBIT 14

News Release

ALLIED Engineered Plastics

Allied Corporation
P.O. Box 2332R
Morristown, NJ 07960

For further information:

Contact Earl Hatley
(201) 455-5407

For Immediate Release

RUTGERS STUDY CONFIRMS NYLON BARRIER PROPERTIES
FOR FOOD AND OTHER SENSITIVE PACKAGING

Nylon film coextrusions offer the most cost-effective barrier for flavors, aromas, and odors for food and other sensitive packaging according to the results of a scientific study undertaken by Rutgers University for Allied Engineered Plastics.

The research project, directed by Dr. Seymour Gilbert, head of the Rutgers University Food Science Department, was the second such investigation commissioned by Allied.

Results from the first study, completed three years ago, also demonstrated nylon's cost-effective barrier properties. In that initial research, film materials tested included polyvinylidene chloride (PVDC), ethyl vinyl alcohol (EVOH), and glassine as well as nylon. Films with thin nylon cores proved to have the broadest range of performance properties with optimum flavor aroma barrier. Only EVOH offered better permeation resistance to acetic acid, ethyl acetate, and toluene, although the nylon films provided acceptable permeation resistance at a cost approximately half that of EVOH.

The second research project sought to determine whether nylon and EVOH in a single specification have a synergistic effect on flavor and aroma which would be cost-effective; and to test other film structures with additional permeants which have a broader range in simulating various flavors and aromas used in

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food, medical, and industrial packaging. Where the first study tested film only at zero percent relative humidity, the present investigation would be conducted under conditions of zero and 80 percent humidity; to date, the only results available from the second study are of film structures tested at zero percent humidity.

Dr. Gilbert, who designed the test cell in which the permeation rates were measured, subjected eight different coextruded film structures to nine different permeants. Film samples were clamped in the permeation cell and test compounds in concentration of 100 ppm were introduced to chambers within the cell. Concentration of test compounds in the chambers were measured by gas chromatograph to determine permeation rate of the compounds.

Permeants selected for the tests were methyl ethyl ketone, ethyl acetate, toluene, (all solvents), methyl solicylote, ethyl phenol acetate, limolene, beta-pinine, styrene, and menthol. These include compounds found in breath freshners, soaps, and other products, flavorants, and permeants used to simulate hydrocarbons, undesireable packaging compounds, and organic compounds used in medicinal packaging.

The findings are particularly important to packagers of shelf stable foods such as packaged baked goods, candles, confections, flavor enhanced cereals, cakes, and snack foods.

Combinations of nylon and EVOH do not, Dr. Gilbert's tests showed, produce a significant synergistic effect in terms of barrier properties compared to a nylon-only coextrusion or an EVOH-only coextrusion.

-more-

In addition, according to test results, the nylon-only coextrusion, or the modified-nylon coextrusion, showed excellent barrier properties for all permeants compared to a PETG coextrusion and a PVDC-coated oriented polypropylene film.

Nylon also offers excellent resistance to grease and oil, and high-temperature performance as well as impact-, puncture-, and tear-resistant properties.

For detailed findings of the second Rutgers study, see the attached tables for measured permeation for all film structures with all tested permeants, and permability ratings (Poor, Fair, Good, Excellent) based on actual laboratory measurements.

For more information, contact Earl Hatley, Product Manager, Allied Engineered Plastics, PO Box 2332R, Morristown, NJ 07960, (201) 455-5407.

Table 1

Permeability in $gr/m^2 \times day \times 100$ ppm at 73°F and 0%RH

Film	Methyl Ethyl Ketone	Ethyl Acetate	Methyl Salicylate	Ethyl Phenyl Acetate	Limonene	B-Pinene	Toluene	Styrene	Menthol
A	0.43	<0.0003	0.0046	0.0085	0.0409	0.0120	0.001	<0.0003	<0.0002
B	0.65	0.30	0.0011	<0.0060	0.0012	0.0013	0.027	0.0610	<0.0001
C	0.90	<0.0004	<0.0003	<0.0080	0.0014	<0.0004	0.002	0.0054	<0.0001
D	0.65	<0.0004	<0.0002	<0.0080	0.0018	<0.0011	0.001	<0.0003	<0.0001
E	0.77	<0.0004	<0.0002	<0.0080	<0.0003	<0.0009	0.0004	0.0005	<0.0001
F	<0.01	<0.0004	0.009	<0.0070	0.0400	0.0036	0.0003	<0.0002	<0.0002
G	2.40	6.86	2.160	0.234	0.0315	0.0088	1.310	0.0018	0.0020
H	0.44	0.52	0.071	0.016	0.0400	0.0320	0.470	0.0046	<0.0002
I	0.02	0.04	0.024	<0.0080	0.0106	<0.0012	0.005	0.0059	0.0011

FILM KEY:

A. HDPE/TIE/NYLON/EVA
B. HDPE/TIE/EVOH/EVA
C. HDPE/TIE/NYLON/TIE/EVOH/TIE/NYLON/TIE/HDPE
D. HDPE/TIE/MODIFIED NYLON/TIE/HDPE
E. NYLON/EVOH/NYLON/TIE/LLDPE/TIE/LLDPE
F. (ORIENTED)PP/TIE/EVOH/TIE/PP
G. PP/TIE/PET/TIE/PP
H. PVDC COATED CO-EX OPP
I. WAX PAPER/GLASSINE

Table 2

Rating Based on Permeability Values at 73°F and %RH

Film	Methyl Ethyl Ketone	Ethyl Acetate	Methyl Salicylate	Ethyl Phenyl Acetate	Limonene	B-Pinene	Toluene	Styrene	Menthol
A	G	E	G	F	G	F	E	E	E
B	F	F	G	E	E	G	G	F	E
C	F	E	E	E	E	E	E	G	E
D	G	E	E	E	E	E	E	E	E
E	F	E	E	E	E	E	E	E	E
F	E	E	G	E	G	G	E	E	E
G	P	P	P	P	G	G	P	G	G
H	G	F	F	G	G	F	F	G	E
I	E	G	G	E	G	E	E	G	G

E : Excellent

G : Good

F : Fair

P : Poor

FILM KEY:

A. HDPE/TIE/NYLON/EVA
B. HDPE/TIE/EVOH/EVA
C. HDPE/TIE/NYLON/TIE/EVOH/TIE/NYLON/TIE/HDPE
D. HDPE/TIE/MODIFIED NYLON/TIE/HDPE
E. NYLON/EVOH/NYLON/TIE/LLDPE/TIE/LLDPE
F. (ORIENTED)PP/TIE/EVOH/TIE/PP
G. PP/TIE/PET/TIE/PP
H. PVDC COATED CO-EX OPP
I. WAX PAPER/GLASSINE

Table 3

Rating	Number
E (Excellent)	4
G (Good)	3
F (Fair)	2
P (Poor)	1

Table 4

Film		Sum for Ratings for Barrier Properties of Flexed Films	Rating Sum
A.	HDPE/TIE/NYLON/EVA	1.25 mil	29
B.	HDPE/TIE/EVOH/EVA	1.25 mil	27
C.	HDPE/TIE/NYLON/TIE/EVOH/TIE/NYLON/TIE/HDPE	1.40 mil	33
D.	HDPE/TIE/MODIFIED NYLON/TIE/HDPE	2.20 mil	35
E.	NYLON/EVOH/NYLON/TIE/LLDPE/TIE/LLDPE	3.50 mil	34
F.	(ORIENTED) PP/TIE/EVOH/TIE/PP	1.00 mil	33
G.	PP/TIE/PET/TIE/PP	1.00 mil	22
H.	PVDC COATED CO-EX OPP	1.80 mil	24
I.	Wax Paper/Glassine		31 (unflexed)

TAB D

TO EXHIBIT 14

D

2 March-April 1987
Volume 52, No. 2

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Odor Barrier Properties of Multi-Layer Packaging Films at Different Relative Humidities

E. HATZIDIMITRIU, S. G. GILBERT, and G. LOUKAKIS

ABSTRACT

A permeation cell method was developed for the determination of transmission rates of organic vapors through flexible packaging materials. The permeation rates at 23°C of some compounds for several composite films at 0% and 75% relative humidity (RH) indicated that the polyethylene vinyl alcohol and nylon combinations exhibited superior barrier properties even at elevated RH, provided that moisture barrier films were present in the laminate construction.

INTRODUCTION

THE EXPANDING USE of plastics in packaging applications competing with glass and metal puts great emphasis on the high barrier properties of the involved materials against moisture and glass (Allison, 1985) to assure an acceptable shelf life of a packaged product.

The permeation of packaging materials to odorous vapors is of significant importance, either to protect the contents against contamination from foreign odors or to retain favorable volatile flavors. Although the permeation rates of permanent gases and water vapor through many plastics have been obtained, there is a deficiency of data for permeation of organic vapors (Zobel, 1985).

The object of this study was to develop a method for quantitative evaluation of the aroma barrier of packaging materials. A series of flexible plastic films of various compositions were then tested for their permeability to some flavoring and malodorous compounds.

MATERIALS & METHODS

THE METHOD is based on the Gilbert-Pegaz permeation cell (Gilbert and Pegaz, 1969). As Fig. 1 indicates, the cell can accomodate simultaneously two films by clamping each between aluminum devices to form a pair of outer chambers and a single inner one (Gilbert et al., 1983). The devices are equipped with Viton O-rings to assure good seal between the films and the surroundings. Chambers on either side of the film have valves for inlet and outlet of permeant supply and septa for sampling.

Nitrogen is bubbled through the liquid permeant and then passed with the permeant vapors through either the middle chamber or the lower and upper compartments. Thus either one cell can be used for duplicates or in the case of very good barriers, the exposed area can be doubled. The nitrogen stream carrying the permeant vapors can be mixed before the cell with either dry or wet nitrogen to adjust the permeant final concentration or the relative humidity of the high concentration chamber. In the case of permeants with very low vapor pressure at ambient temperature, a small amount can be placed in an aluminum dish on the bottom of the cell. If adjustment of the humidity is desired, another dish with an aqueous saturated salt solution can also be placed on the bottom (Fig. 2).

The tested films appear in Table 1 with their respective compositions and thicknesses. Each film was Gelbo flexed (ASTM, 1982) for 20 cycles prior to testing to simulate severe abuse which may be encountered in packaging and distribution. All films to be exposed to a 75% RH environment at 23°C were kept for a period of 2 wk in a desiccator over saturated sodium chloride solution. Then they were tested with the permeant vapor stream combined with controlled humidity nitrogen to provide the elevated humidity level during testing. The permeants used for the tests are also given in Table 1.

The concentrations of the permeating vapors and related humidity were monitored by gas chromatography with removal of small aliquots

Table 1—Films used for the permeation studies

A. 1.25 Mil HDPE/TIE/NYLON/EVA
B. 1.25 Mil HDPE/TIE/EVOH/EVA
C. 1.40 Mil HDPE/TIE/NYLON/EVOH/NYLON/TIE/HDPE
D. 2.20 Mil HDPE/TIE/MODIFIED/NYLON/TIE/HDPE
E. 1.0 Mil (oriented) PP/TIE/EVOH/TIE/PP
F. 1.0 Mil PP/TIE/PET-G/TIE/PP
G. 1.8 Mil PVDC coated co-ex OPP

Where: HDPE	= High density polyethylene
TIE	= Adhesive layer
NYLON	= Nylon 6
EVA	= Polyethylene vinyl acetate
EVOH	= Polyethylene vinyl alcohol
Modified NYLON	= Mineral filled nylon-6
PP	= Polypropylene
PET-G	= Polyethylene terephthalate-glycol
PVDC	= Polyvinylidene chloride
OPP	= Oriented polypropylene

Permeants used for the test

1. Ethyl acetate	4. Limonene
2. Toluene	5. beta-Pinene
3. Styrene	6. Ethyl phenyl acetate

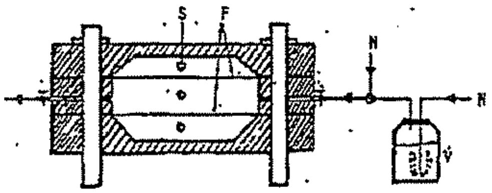

Fig. 1—Permeation cell arrangement for high vapor pressure permeants: (N) Nitrogen inlet; (V) Glass vial containing liquid permeant; (F) Film samples; (S) Septa for sampling.

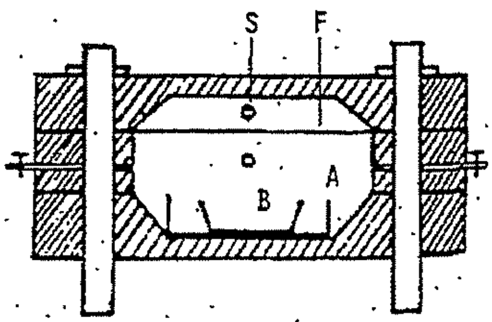

Fig. 2—Permeation cell arrangement for low vapor permeants: (A) Dish with aqueous saturated salt solution; (B) Dish with permeant; (F) Film sample; (S) Septa for sampling.

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Table 2—Permeation Rates, 0% RH, 2°C (g/m²·day·100 ppm)

Film	Ethyl acetate	Toluene	Styrene	Limonene	B-Pinene	Ethyl phenyl acetate
A	<0.003	0.001	<0.0003	0.0409	0.0120	0.0085
B	0.30	0.027	0.0510	0.0012	0.0013	<0.0060
C	<0.0004	0.002	0.0054	0.0014	<0.0004	<0.0080
D	<0.0004	0.001	<0.0003	0.0018	<0.0011	<0.0080
E	<0.0004	0.0003	<0.0002	0.0400	<0.0036	<0.0070
F	6.86	1.310	0.0018	0.0315	0.0088	0.234
G	0.52	0.470	0.0045	0.0400	0.0320	0.018

Table 3—Permeation Rates, 75% RH, 23°C (g/m²·day·100 ppm)

Film	Ethyl acetate	Toluene	Styrene	Limonene	B-Pinene	Ethyl phenyl acetate
A	0.0632	0.0159	0.0120	0.0009	0.0013	0.0053
B	0.0034	0.0050	0.0037	0.0037	0.0001	<0.002
C	0.0041	0.0088	0.0050	<0.0003	0.0049	<0.002
D	0.0068	0.0008	0.0046	0.0078	0.0020	0.0076
E	0.0082	0.0034	0.0338	0.0061	0.0031	0.0061
F	0.0040	0.0020	0.0096	0.0071	too fast	0.0071
G	0.0095	0.0007	0.0061	0.0050	0.1419	0.0060

using a gas tight syringe (Gilbert and Pegaz, 1969). The plot of the monitored concentration versus sampling time gives the permeation curve. The slope of the steady state portion was determined and used in combination with the chamber volume, exposed film surface and permeant concentration difference across the film for the calculation of permeation rate in appropriate units.

However, for anomalous diffusion, often found with glassy and semicrystalline polymers (Crank and Park, 1968), when the obtained permeation curves did not show a constant or steady state rate following a lag phase; the linear portion of the permeation curve was used after a testing period of two weeks. With very good barriers no significant permeating amount could be detected for certain permeants. In this case the rate was expressed as a value below the detection limit of the gas chromatograph for the permeant driving force across the film.

While a normalized driving force was used in the calculation of the permeation coefficient, the actual driving force depended on the vapor pressure of the permeant at the test temperature. For a specific permeant all films were tested at the same vapor driving force concentration for both relative humidities. Linear concentration dependence of permeation rate was assumed, although this might not be the case, especially with organic vapors (Zobel, 1985).

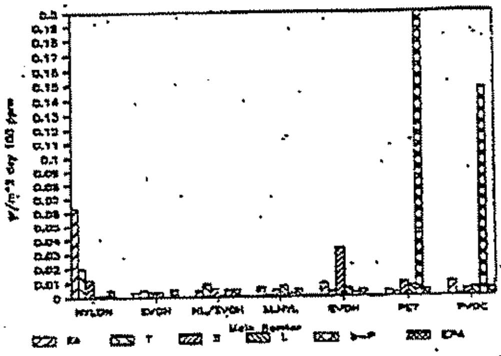

Fig. 3—Permeation rates at 0% RH, 23°C. EA:ethyl acetate, T:toluene, S:styrene, L:limonene, b-B:beta pinene, EPA:ethyl phenyl acetate.

RESULTS & DISCUSSION

THE CALCULATED PERMEATION rates for each film and permeant are given in Table 2 for 0% RH, and Table 3 for 75% RH, respectively. The indicated values were normalized to 100 ppm (g permeant/cc of air) permeant concentration difference across the film. For comparison purposes the values from Tables 2 and 3 are presented in Fig. 3 and 4, respectively. It should be emphasized that normalizing the permeation rate to a unit driving force concentration, allows for a comparison of relative barrier properties of the tested films at only one vapor concentration. However this relationship may change as the vapor concentration is changed.

At 0% RH the nylon-EVOH and modified nylon 6 structures exhibited the best barrier properties for all the permeants (Fig. 3). The nylon-6 and both EVOH films followed next although the HDPE/EVOH/EVA combination was significantly more permeable to ethyl acetate. The PET and PVDC structures had the least barrier performance at 0% RH, especially for ethyl acetate and toluene, with PET much more inferior than PVDC.

For the 75% RH environment all the tested films exhibited almost equivalent barrier properties, with some exceptions for certain permeants. PET and PVDC were very permeable to beta-pinene. Also, the PP/EVOH/PP film appeared sensitive to styrene, and the HDPE/nylon 6/EVA structure had a lower barrier to ethyl acetate and toluene compared to EVOH and modified nylon. Overall at 75% RH the best barrier performance can be attributed to nylon 6/EVOH, modified nylon-6

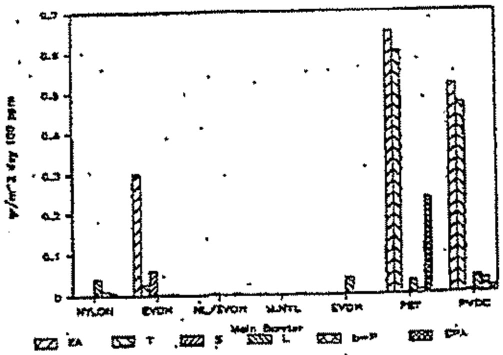

Fig. 4—Permeation rates at 75% RH, 23°C. EA:ethyl acetate, T:toluene, S:styrene, L:limonene, b-B:beta pinene, EPA:ethyl phenyl acetate.

Table 4—Ethyle Acetate Permeation Tests, 23°C, 93% RH

Film	Lag time (hr)	Permeation rate (g/m²·day·100 ppm)
A	5.6	0.247
B	24.2	0.021

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and both EVOH combinations. The HDPE/nylon 6 EVA film lost its excellent barrier properties at this RH level probably due to moisture sorption from the polyamide.

Although polyethylene vinyl alcohol (EVOH) also sorbed water, the resulting structure change at the 75% RH did not affect the permeation as much as in nylon-6. A similar difference was observed with polyvinyl alcohol and nylon-6 films for carbon dioxide and oxygen permeation (Ito, 1961; Meyer et al., 1957; Toyoshima, 1973). At 75% RH, polyvinyl alcohol was a better barrier than nylon-6 for the above gases. However, the opposite was true at 93% RH. This could be attributed to higher water sorption by polyvinyl alcohol at 93%, possibly because of a more disrupted structure for the polymer compared to nylon 6.

To determine whether EVOH, despite its ethylene content, would exhibit a similar barrier change at 93% RH as polyvinyl alcohol, when compared to nylon-6, the films HDPE/nylon 6/EVA and HDPE/EVOH/EVA were tested at 93% RH for ethyl acetate permeation. The test results are given in Table 4. The permeation rate at the steady state for nylon-6 was about twelve times faster than for EVOH. This did not agree with what was observed for permanent gases and can be attributed to the ethylene content (about 35% w/w) of EVOH. The ethylene modified the polymer structure so it was not disrupted by water sorption as much as in polyvinyl alcohol.

The lag-time, which is related to the diffusivity through the film (Crank and Park, 1968), was about four times slower for nylon-6 versus EVOH (Table 4). This indicated that ethyl acetate could diffuse four times faster in nylon 6 than in EVOH at 90% RH.

CONCLUSIONS

The nylon and polyethylene vinyl alcohol (EVOH) laminations at 0% RH appeared to have the best barrier performance which was superior to the polyethylene terephthalate-glycol (PET-G) and polyvinyledene chloride (PVDC) laminations.

A similar trend was observed even at the 75% RH level, where the water sensitive nylon and EVOH seemed to be generally well protected by the outer hydrophobic laminates. Thus the nylon and EVOH combinations maintained a superior barrier performance compared to PET-G and PVDC.

The determined barrier properties of the tested films could help in designing packaging materials which could offer better aroma protection and consequently contribute to qualitative and quantitative shelf life improvement.

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proteases of different specificities is now being tested to further improve the present data.

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PPPI 008456

TAB E

TO EXHIBIT 14

SPEECH

Good Morning Ladies and Gentlemen. My name is Earl Hatley and I'm with the Allied Corporation in the Engineered Plastics Division. I want to thank the Society of Plastic Engineers Chicago Section for inviting me here this afternoon to speak to

SLIDE 1

you regarding nylon and its various performance properties. In fact, the name of my paper is "The Performance of Nylon Particularly as a Flavor Aroma and Odor Barrier".

As some of you may be aware Allied Corporation entered into a flavor and aroma barrier study with Dr. Seymour Gilbert at the Rutgers University approximately three years ago. We initiated the study with Dr. Gilbert because at the time there was much discussion in the trade regarding flavor and aroma barriers but there was no empirical data available to substantiate what many felt was taking place. Several of our customer converters had done very preliminary type testing and had gotten an indication that nylon was a very effective flavor aroma and odor barrier. However, there was no objective knowledge such as you would obtain from an university study.

Allied commissioned Rutgers University to study and compare the flavor and aroma barrier properties of commercially available packaging materials with common organic compounds associated with food ingredients and laminated materials used for food packaging.

The film materials tested included nylon, polyvinylidene chloride (PVDC), ethyl vinyl alcohol (EVOH), and glassine. Those

results indicated that nylon provided good to excellent protection against the permeation of flavors and aromas and offers one of the most economical barriers per mil thickness.

I might add that nylon also provides excellent grease and oil resistance in high temperature performance as well as impact, puncture, and tear resistant properties. The study indicated that coextruded films with thin nylon cores proved to have the broadest range of performance properties of the films tested with optimum flavor aroma barrier.

SLIDE 2
Properties

This first Rutgers study represented the first time that data had been compiled for specific permeants that affect flavor and aroma barriers of packaged foods. The testing procedure involved the use of a special permeation cell developed by Dr. Gilbert. Test films were pre-conditioned and aged for ten days at 70°F and 100% relative humidity and Gelboflexed for 20 times to simulate shipping and handling conditions.

SLIDE 3
TEST
CONDITIONS

In the first and second studies, film samples were clamped in the permeation cell and test compounds ~~and~~ OF concentrations of 100 parts per million were introduced to chambers within the cell. At intervals the concentrations of test compounds in the chambers were measured by gas chromatograph to determine the permeation rate of the compounds. The items tests included allyl sulfide (oil of garlic) and acetic acid (vinegar); methyl ethyl ketone and ethyl acetate (solvents used in food packaging); and toluene (aromatic chemical used to simulate automobile and truck exhaust).

SLIDE 4
definitions

SLIDE 5
(cell)

SLIDE 6
diagram

A special note there was one deviation on the test method which had to be used for ethyl phenol acetate. Due to the low vapor pressure of this permeant at 73°F only one film sample was used per permeation cell according to Dr. Gilbert. An aluminum weighing dish containing the permeant was placed on the bottom of each cell. Then the film was placed above the dish and clamped between the upper and lower compartments of the cell. Thus, the upper part was a low concentration side while the lower one was saturated with vapors of the permeant.

SLIDE 7

In this first study the nylon film coextrusion outperformed the other film structures tested with the exception of the ones including EVOH, which proved a better permeation resistance to acetic acid, ethyl acetate and toluene. In all instances, however, the performance of nylon film proved acceptability compared with EVOH which, as you may know, is probably twice the cost of nylon in resin form.

SLIDE 8 BLANK 1st study

As some of you may be aware nylon and EVOH are used together in film structures sandwiched as core layers between layers of high density polyethylene or other polyolefins, for moisture protection, to provide extremely functional specifications especially in the area of thermoforming applications where EVOH has provided the oxygen barrier and nylon also the oxygen barrier but more importantly nylon gives it the strength for thermoforming without flex cracking. In these specifications nylon forms an inseparable bond with EVOH protecting the more sensitive EVOH

from heat degradation and flex cracking and may serve as a moisture absorber according to some of our clients. Both nylon and EVOH have excellent oxygen barriers.

SLIDE 9

OBJECTIVE

Do to the results of the first Rutgers study, which indicated that both nylon and EVOH are effective flavor and aroma barriers, we decided to commission Rutgers to do a second flavor and aroma study to determine the following objectives:

(1) To determine whether nylon and EVOH in a single specification have a synergistic effect on flavor and aroma which becomes cost effective.

(2) To test additional permeants which have a broader range in simulating various flavors and aromas used in food, medical, and industrial packaging, and additional polymers/structures to these permeants to test their barrier properties.

(3) To test under 0% relative humidity as done in the first study but more importantly to also test under high relative humidity, that is 80%, to see the effects of moisture on flavor, aroma, and odor barrier properties.

SLIDE 10

permeants

The permeants which were tested in the second study were as follows:

(1) Methyl Ethyl Ketone, a solvent.

(2) Ethyl Acetate, a solvent.

(3) Methyl Salicylate, a permeant found in breath fresheners and other products.

(4) Ethyl Phenol Acetate, a permeant found in soaps and products of that nature.

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(5) Limolene, a permeant simulating flavorant found in various confections.

(6) Beta-pinine, a permeant found in various household cleaners.

(7) Toluene, a solvent used to simulate various hydrocarbons especially in motor fuels, and diesel exhausts.

(8) Styrene, a permeant used to simulate various undesireable compounds that might migrate into food stuffs through packaging or from packaging materials.

(9) Menthol, a permeant design to simulate the types of organic compounds used not only in breath fresheners, and tobacco products but also to simulate in organic compounds used in medicinal packaging.

The packaging structures tested were those that can be commercially produced. Some of which are commercially produced others of which are developmental. Those structures were as follows:

a) 1.25 mil coextrusion containing high density polyethylene - Tie - nylon - EVA.

b) 1.25 mil coextrusion containing high density polyethylene - Tie - EVOH - EVA.

c) 1.4 mil coextrusion containing high density polyethylene - Tie - nylon - Tie - EVOH - Tie - nylon-Tie-high density polyethylene.

d) 2.2 mil coextrusion containing high density polyethylene - Tie - modified nylon - Tie - high density polyethylene.

e) 3.5 mil coextrusion containing nylon - EVOH - nylon - Tie linear low density polyethylene - Tie - linear low density polyethylene.

f) 1 mil oriented film polypropylene copolymer-Tie - PETG - Tie - copolymer polypropylene.

h) 1.8 mil PVDC coated coextruded oriented polypropylene.

i) 53 pound wax paper, 4 pounds paraffin wax - 20 pounds glassine - 7-1/2 pounds microcrystalline wax - 20 pounds glassine - 4 pounds paraffin wax.

The data I am about to present were tested under the following conditions: Temperature was 73°F. Moisture 0% relative humidity. Material abuse all films except Item I were gelbolflexed 20 cycles. Film I was creased at 180° once and released to flat.

TIDE 12 SELEO

We reasoned that by creasing the 53 pounds wax paper once and releasing to flat, we were simulating as best as possible the type of abuse that this material gets by manufacturers when its folded and made into a pouch on a double package maker machine.

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I think that perhaps we were too kind to this material because in reviewing the procedures and the way the material is handled on the machine, it is probably abused more than what we've given it.

In addition, the data that I'll be presenting to you this afternoon on the second flavor aroma study that we've done at Rutgers will be under 0% relative humidity only. The higher humidity, that is under 80% relative humidity, on the same structures is now in progress and will not be completed in November.

The tables you are about to see are all presented in permeabilities of grams per square meter per day at a permeant concentration of 100 parts per million.

As you can see from the first slide we are presenting for methyl ethyl ketone there is significant barrier properties for a number of the structures which we have tested. You'll note that for the value of .43 for the Item A which is the high density PE-nylon-EVA compared to the .65 for Item B which is the high density PE-EVOH-EVA. Those structures are very identical in makeup with only the barrier being different. That is the actual thickness of materials is about the same.

SLIDE 13
MEK

The value obtained for the coextrusion in Item C is .90. You'll note that our findings are somewhat surprising on this structure because you really don't get that much more barrier property from a combination of nylon EVOH nylon in a coextruded structure as we had hypothesized from the initial reports. The

values of the first three items are very similar in numerical content. When your measuring at grams per square meter per day, either one of these values is considered to be a very good barrier.

You'll notice for Item D the high density PE-modified nylon-high density PE a value of .77, again very comparable to the first three items that are presented.

This structure has a modified nylon in it whereas Item A has a straight nylon 6, Item B EVOH only and Item C a combination of nylon six and EVOH.

You'll notice for Item E the nylon EVOH nylon linear low density linear low density coextrusion at 3.5 mils. That value was .77 again very similar to the first four that are presented. We suspect that this one may not be showing quite as good as we would have expected due to the thickness and the gelboflexing. We've found thinner is better in coextrusions when gelbolflexing and to simulating abuse. Several of our converter customers tell us that that is also their findings.

Item F, you'll notice that there's a very good barrier found of less than .01 for the oriented coextrusion consisting of copolymer polypropylene-EVOH-copolymer polypropylene. This ~~finding~~ value ~~really~~ correlates ~~substantiates~~ the finding that we found in the first study for EVOH and MEK wherein we found a similar very good barrier for EVOH. ~~In the first study we found the value of .09 for unoriented EVOH~~. Here were finding a value of .01 for oriented

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Item B is unoriented
EVOH. ~~So both values are excellent~~. It's questionable here whether the addition of orientation provides that much more barrier for the money. Of course, when you orient you'd be doing that to obtain additional properties for your purpose.

Item G, the coextrusion containing polypropylene PETG polypropylene. You notice there's a very poor finding of 2.4 grams for methyl ethyl ketone permeant passing through the PETG. Dr. Gilbert had indicated to us that he expected this type of finding and so we were not surprised that the PETG proved to have a very poor functional barrier for solvents.

Item H is the 1.8 mil PVDC coated coextruded oriented polypropylene with a barrier of .44 for methyl ethyl ketone. This has proved to be a fairly good barrier in this study, however, in the first study we tested a different type of PVDC polypropylene and for MEK we got a barrier of 3 grams. The second film is thicker, the orientation may be different, and there's a different PVDC. These films are from different manufacturers.

Item I which is the 53 pound wax paper, you note has the best barrier of any of the structures at .02 for MEK. The large food processing manufacturer who supplied this material to us did indicate that their own test had showed that it was a pretty good barrier for some permeants.

The next slide we want to present is that of ethyl acetate as
SLIDE 14 a permeant simulating solvents used in food packaging and also
E.A

represent some flavorants in food processing. You'll notice from the slide that the first six items all represent a very good barrier. They're all fairly equal with slight differences in the value. However for Item G, which is the coextruded polypropylene PETG polypropylene structure, its not a very good barrier for ethyl acetate, fully 6.86 grams going through that structure under dry conditions and I don't think you'd want to chose that to protect your product if it were in a lamination where they're using ethyl acetate as a solvent to cut adhesives etc. The remaining two items, the PVDC coated coextruded polypropylene-a good barrier, and last but not least the 53 pound wax paper-an excellent barrier for ethyl acetate at .04 grams. Dr. Gilbert indicates that ethyl acetate will also simulate a banana type aroma. Here, there are at least eight of the structures that may be contenders for that type of barrier packaging.

The next slide we want to present is for menthol salicylate. You'll notice that for the first six structures there is a very good barrier found for this permeant. As you may recall you've LINE 15 seen this used in breath fresheners and that type of product as well as others. However, again in Item G which is the coextruded polypropylene PETG polypropylene, the barrier is not very desirable, 2.16 grams per square meter. To review we have found for methyl ethyl ketone, ethyl acetate and menthol salicytate, that PETG is not a very effective barrier if you were to consider using PETG in a coextrusion.

Notice structure H, .87 grams not as good as the other barriers involved, in fact, it is significantly lesser of a barrier for the menthol salicylate than either of the first six items.

Item I, the 53 pound wax paper again makes a very good showing as far as a barrier property for menthol salieylate at .024 grams.

The next slide we'll present is on ethyl phenol acetate a permeant which is used to simulate the type of aromas we find in soaps, etc.

2/DE76

You'll note for the first six structures that the barriers are just about equal for ethyl phenol acetate. As I have mentioned in my earlier remarks for methyl ethyl ketone, this permeant also demonstrates that there really is not that much of a synergistic effect in terms of combining nylon and EVOH in a packaging structure to gain an even better barrier than you would by specifying either nylon by itself or either EVOH by itself in a packaging structure. Of course if you combine nylon and EVOH in a structure you may be doing that to get a super oxygen barrier one of which you would not be able to obtain with the nylon by itself.

The value obtained for phenol ethyl acetate for Item G, the PETG coextrusion is significantly not as good as the first six items. Item H, the PVDC coated oriented polypropylene makes a good showing at .016 grams. Item I, the 53 pound wax paper is

good odor structure at .008 grams per square meter for the permeant.

The next slide is for limonene, a permeant used to simulate the lemon flavor. You'll note for the values we have expressed for the first six coextrusions incorporating nylon by itself, EVOH by itself, combinations of nylon and EVOH, modified nylon, and the orientation effect; that the barriers are pretty much comparable for each of these items. Structure G which has not made a good showing in previous permeants does comparably to the first six structures with a .03 value as does Structure H which is the PVDC coated oriented polypropylene, and Structure I - 53 pound wax paper. All nine structures prove to be a good barriers for the limonene.

SLIDE 17

The next slide is for Beta- pinene which is used to simulate the type of odors you'd find in household cleaners. You'll notice that all nine structures are a good barrier to Beta - pinene with, some of course, being significantly better than others. For example Item C which is the nylon EVOH combination does prove to have one of the better barriers for this type of packaging. You'll note for Item H which is the PVDC coated oriented polypropylene is the least desireable of the group at .03 grams per square meter.

SLIDE 18

The next slide is for toluene. This permeant is probably the one that is most often used by food packagers to simulate the types of environmental conditions that food products are exposed to in the distribution system especially through trucking.

SLIDE 19

We are first alerted to this permeant by a major confectionary manufacturer who had discovered that his products were picking up odors in transit. By testing with toluene he found it was the diesel exhaust or aromatic hydrocarbon in the exhaust that were permeating his packaging and effecting his product and staling it. He has subsequently changed his package to an intermediate structure, however, is still desiring to get a coextrusion containing nylon which will be a better barrier to toluene then the structure he is currently using.

You'll note from the slide that the first six structures that we've discussed prior do show good barrier for toluene, however, noticing Item H the PVDC coated oriented polypropylene that is significantly different at .47 then the others. This happens to be the structure I spoke about earlier. You notice that Item A which is a nylon containing coextrusion is .001 versus Item H which is .47; that difference in permeation is the manufacturer's reason he desires to change to a nylon coextrusion if he could find one that would be machinable and process in his plants. You'll notice Item G the PETG coextrusion is the most undesirable barrier structure of all for toluene.

The next slide we want to present is for styrene. You notice that for each of the structures there's a good barrier for

SLIDE 20

styrene. The nylon only coextrusion, and the modified nylon coextrusion, as well as the nylon EVOH nylon 3-1/2 mil structure,

and the oriented EVOH structure all make very good showings as far as barrier for styrene. You'll notice there may be an orientation effect on the EVOH since the unoriented coextrusion with EVOH is .06 whereas the oriented coextrusion with EVOH is .0002. It's a challenge to analyze differences such as these in searching for explanations of the effects of various polymers and machining techniques for barrier properties.

SLIDE 20 The next slide ~~8~~ is for ~~methanol~~ MENTHOL. All nine structures involved have an excellent barrier to ~~methanol.~~ MENTHOL.

SLIDE 21 Now there is significant data presented here for you to assimulate in this short time. SLIDE 22 Rutgers University has made up a rating system for the permeants in each of their classes. This next slide shows this rating system based on Excellent-E, Good-G, Fair-F and Poor-P. The ratings are not to be taken of one column versus another column. The rating are only to be used on one structure versus the other structure for the permeant tested. SLIDE 23 Dr. Gilbert has assigned numerical values for each letter code represented by the next chart. For Excellent, he assigned a value of four (4). For Good a value of three (3), and for Fair and value of two (2) with Poor being a value of one (1). The cumulative ratings are as follows.

LIDE 21 all removed

LIDE 22 ratings

LIDE 23 ratings + values.

You'll notice that the overall rating of the high density modified nylon high density represented by Structure D is best.

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The modification within nylon is still in the developmental stages but suffice to say that it is extremely cost effective. If you were to compare this structure versus the one represented in B which is an EVOH specification you would get an excellent barrier. Using the modified nylon would be more cost effective than if you were to use other more expensive polymers.

SLIDE 24 Ital

As in our first study through Rutgers University the second study also indicates that nylon is the most cost effective barrier for flavors, aromas and odors. As mentioned earlier in the discussion, the table representing the raw data for all the permeants indicates that by combining nylon and EVOH together there is not a significant synergistic effect in terms of barrier properties compared to a nylon only containing coextrusion or an EVOH only containing coextrusion whether they be oriented or unoriented. In addition the cost effective nylon only coextrusion or the modified nylon coextrusion makes an excellent showing for all the permeants versus the PETG coextrusion and the PVDC coated oriented polypropylene film. It is noted that the 53 pound wax paper does make a very good showing as far as the barrier material is concerned. However, we are told that this material is becoming extremely costly and there are limited manufacturers these days. Also this material has limited application since it is currently used ~~as~~ ONLY IN liner stock for certain dry foods. It is opaque in color, does not have applicable tensile strength, impact strength, and a number of other desirable features that you would find in a plastic film.

SLIDE 25 cost effective

We think you'll agree that the second study is very significant in terms of gathering data for those of you who are searching for a cost effective barrier to engineer for your customers or for your company if you are employed by a food, medical, or industrial company. The findings are particularly important to those of you as packagers of shelf stable foods whether your packaging baked goods, candies, confections, flavor enhanced cereals, cake mixes or snack foods which need to keep their flavors in for long periods and keep out odors and flavors during handling, shipping and storage.

We thank you for allowing us to present this to you today and we will have the balance of our information in December of 1985 for 80% relative humidity testing of the same structures.

Table 1:

Permeability in $gr/m^2 x day x 100$ ppm at 73°F and 0%RH

Film	Methyl Ethyl Ketone	Ethyl Acetate	Methyl Salicylate	Ethyl Phenyl Acetate	Limonene	B-Pinene	Toluene	Styrene	Menthol
A	0.43	<0.0003	0.0046	0.0085	0.0409	0.0120	0.001	<0.0003	<0.0002
B	0.65	0.30	0.0011	<0.0060	0.0012	0.0013	0.027	0.0610	<0.0001
C	0.90	<0.0004	<0.0003	<0.0080	0.0014	<0.0004	0.002	0.0054	<0.0001
D	0.65	<0.0004	<0.0002	<0.0080	0.0018	<0.0011	0.001	<0.0003	<0.0001
E	0.77	<0.0004	<0.0002	<0.0080	<0.0003	<0.0009	0.0004	0.0005	<0.0001
F	<0.01	<0.0004	0.009	<0.0070	0.0400	0.0036	0.0003	<0.0002	<0.0002
G	2.40	6.86	2.160	0.234	0.0315	0.0088	1.310	0.0018	0.0020
H	0.44	0.52	0.871	0.016	0.0400	0.0320	0.470	0.0046	<0.0002
I	0.02	0.04	0.024	<0.0080	0.0106	<0.0012	0.005	0.0059	0.0011

Table 2

Rating Based on Permeability Values at 73^{o}F and %RH

Film	Methyl Ethyl Ketone	Ethyl Acetate	Methyl Salicylate	Ethyl Phenyl Acetate	Limonene	B-Pinene	Toluene	Styrene	Menthol
A	G	E	G	F	G	F	E	E	E
B	F	F	G	E	E	G	G	F	E
C	F	E	E	E	E	E	E	G	E
D	G	E	E	E	E	E	E	E	E
E	F	E	E	E	E	E	E	E	E
F	E	E	G	E	G	G	E	E	E
G	P	P	P	P	G	G	P	G	G
H	G	F	F	G	G	F	F	G	E
I	E	G	G	E	G	E	E	G	G

E : Excellent

G : Good

F : Fair

P : Poor

Table 3

Rating	Number
E (Excellent)	4
G (Good)	3
F (Fair)	2
P (Poor)	1

Table 4

Film	Sum for Ratings for Barrier Properties of flexed films	Rating Sum
A. HDPE/NYLON/EVA	1.25 mil	29
B. HDPE/EVOH/EVA	1.25 mil	27
C. HDPE/NYLON/EVOH/NYLON/HDPE	1.40 mil	33
D. HDPE/MOD. NYLON/HDPE	2.20 mil	35
E. NYLON/EVOH/NYLON/LLDPE/LLDPE	3.50 mil	34
F. OPP/EVOH/PP	1.00 mil	33
G. PP/PET-G/PP	1.00 mil	22
H. PVDC Coated Co-Ex OPP	1.80 mil	24
I. Wax paper/Glassine		31(unflexed